Government of Canada / Gouvernement du Canada
Canadian Forestry Service / Service Canadien des forêts

ISSN 0820-8107

NO. 161

Canadian Forestry Service-Maritimes

TECHNICAL NOTE

CONE RUST, A POTENTIAL PROBLEM IN WHITE SPRUCE SEED ORCHARDS

Seed orchards are among the most expensive forestry "real estate" we possess. Because of their extremely high value, factors that either directly or indirectly reduce seed production in these orchards MUST be minimized.

In 1984, the cone rust fungus Pucciniastrum americanum greatly reduced both the quantity and quality of seed produced in heavily infected cones. Samples showed that heavily infected cones produced only 35% of their expected complement of sound seed. Moreover, up to 80% of the seed that appeared to be sound, failed to germinate. Germination was also reduced in lightly infected cones.

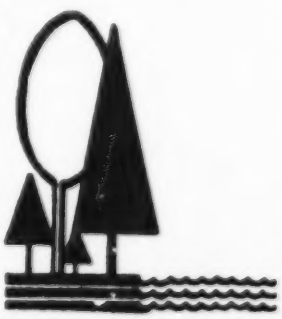
Background

A rust fungus, affecting the cones of white spruce reached epidemic proportions throughout New Brunswick in 1984, coinciding with an excellent cone crop.

The 1984 annual report of the Forest Insect and Disease Survey (FIDS) (Magasi, 1985) described the situation as follows:

> "The fungus, Pucciniastrum americanum (Farl.) Arth. has been previously reported on cone scales in Canada only from British Columbia in 1962 and from New Brunswick in 1982 and 1983. In the past it has been considered a needle or cone rust of no significance. In 1984, there was a bumper cone crop on white spruce in New Brunswick and the weather was wet and humid in the early part of the season. The combination of the presence of cones, ideal conditions for spore germination and the abundance of raspberry, the alternate host required by P. americanum to complete its life cycle resulted in very high levels of

NURSERIES
PLANTATIONS
SILVICULTURE
UTILIZATION
ECONOMICS
TREE IMPROVEMENT
INSECTS AND DISEASES



Canadian Forestry Service - Maritimes
P.O. Box 4000, Fredericton, N.B. E3B 5P7
P.O. Box 667, Truro, N.S. B2N 5E5
P.O. Box 190, Charlottetown, P.E.I. C1A 7K2

Cette publication est aussi disponible en français sur demande

infection of white spruce cones throughout much of New Brunswick. In some areas the infection was so heavy that, from a distance, the tops of trees actually appeared yellow from the generous production of spores."

"Of 49 areas surveyed for cone rust, the fungus was found in 46, the incidence of infected cones in these 46 areas was 57.7% (range 1 to 100% of cones affected)."

Since the intensity of cone damage by this fungus was unprecedented and total loss of the cone crop occurred at some locations, the effects of infection on seed production and viability were investigated.

Methods

Cones collected from six locations were classified as to the degree of infection. Each class was evaluated in terms of (1) number of seeds per cone, (2) percent of sound seed, and (3) percent of seed germination. Germination tests were conducted according to the International Seed Testing Association (1981) standards, that is, four 100 seed replicates, whenever the number of seed permitted. If seed quantities were low, all available seed was germinated. Sample size varied from 22 to 150 cones per sample (average, 88 cones).

Results

Results, summarized in Table 1, show that infections have a pronounced effect on both the quantity and the quality of seed produced. One or two pustules per cone did not affect either the total number of seeds per cone or the percent of sound seed. However, three or more pustules per cone markedly reduced both number of seeds and percent of sound seed. When infection reached five or more pustules per cone, seed was usually totally destroyed.

Table 1. The effect of cone rust infection on white spruce seed.

Parameter	Assessment								
	Seed/cone (no.)			Sound seed (%)			Germination (%)		
Infection level	U	L	H	U	L	H	U	L	H
Average[1]	56.7	60.5	8.4	32.7	33.0	11.5	26.7	20.0	16.0
Range	45-81	55-60	0-23	21-44	24-42	8-23	2-47	14-26	7-25
No. of tests[2]	5	2	5	3	2	2	3	2	2

[1]Infection levels: U = uninfected ; L = light (1-2 pustules/cone); H = heavy (>3 pustules/cone)

[2]Seed was "immature" when the cones were collected on four of the test sites, hence the percent sound seed and germination percentages were not obtained.

Seed germination decreased with increasing levels of infection but there was no apparent effect on the vigor with which they germinated. However, cones were collected on different dates and because there was no attempt to ensure that the seeds were "mature" at the time of collection, the germination figures were possibly confounded by these two factors.

Discussion

The results from this study and field observations by FIDS indicate that P. americanum has the potential to be a serious problem in white spruce seed orchards, especially during years when spring and early summer are cool and wet. While eliminating all the raspberries (the alternate host for this rust) from the vicinity of orchards would be impractical if not impossible, the presence of this rust further supports the need for weed control within the orchards. Lack of control could result in serious losses of seed production in a given year.

R.F. Smith,[1] L.P. Magasi[2] and K.J. Harrison[2]
May 1986

References

I.S.T.A. 1981. International rules for seed testing. Annexes 1976. Seed Sci. Tech. 4:51-177.

Magasi, L.P. 1985. Forest pest conditions in the Maritimes in 1984. Can. For. Serv., Marit. For. Res. Cent. Inf. Rep. M-X-154.

[1]Tree Improvement
[2]Forest Insect and Disease Survey